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George H. Ashley, State Geologist.

GAS AND OIL IN POTTER CO., PENNSYLVANIA

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Figure I. Areal geology of Potter Co.
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III. Development map of Hebron Field.

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INTRODUCTION

Most of Potter County's oil and gas production has come from the northwestern part of the county. Ninety odd per cent of its proven area is classed as dominantly gas-producing, the only dominantly oil-producing acreage being a small area in the extreme northwestern part of Sharon Township (see Fig. 2) and another north of Hebron Center.

Previous to 1931 all of the county's production came from relatively shallow sands (750 to 2400 ft.), wells commonly were small (10 to 100M) and rock pressures low (10 - 600 lbs.); the pools approached exhaustion. In November 1931 gas was discovered in the Oriskany sand in Hebron Township at a depth of about 5,000 feet. The discovery well was rated at 8 million cubic feet a day with rock pressure of 2,100 pounds per square inch. This discovery was made 14 months after a similar find in adjacent Tioga County and gave to the gas industry of Potter County a new lease of life.

February 1, 1934, 39 locations had been active in exploring the Oriskany. Of these 17 are gas wells, 9 are dry, 2 are definitely abandoned above the sand, 1 is temporarily abandoned, and 10 are drilling or are temporarily inactive.

Fourteen of the successful wells are in Hebron Field; three scattered wells may indicate other pools.

This paper supplements the Pennsylvania Geological Survey Bulletin No. 105 issued in July 1932. Most of the geologic information presented is primarily of reconnaissance value as the geology of Potter County has not been studied in detail.

Production Statistics*

An idea of the magnitude of Potter County's oil and gas industry is given by the following table:

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* See - Contributions to Oil and Gas Geology, Pennsylvania Geol. Survey, Bulletin M-19, 1933.

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Oil and gas produced in Potter County, 1921-32

Year	Oil produced bbls.	Number producing oil wells	Ave. annual production per well,bbl.	Gas produced in thousands of M. cu.ft.	Number producin gas well
1921	13,612	271	50.2		
1922	13,375	270	49.5		
1923	12,135	270	44.9		
1924	10,011	240	41.7		
1925	11,686	252	46.4		
1926	7,395	234	31.6		
1927	6,860	233	29.4		
1928	8,849	251	35.3		
1929	3,122	261	11.9		
1930	5,863	292	20.1		
1931	6,206	231	26.9	839,988	993
1932				2,074,763	1,038

Figures on gas* are not available by counties for years prior to 1931. The increased production of 1932 is largely from the Hebron (Oriskany) Field, which produced about half a billion cubic feet. In 1933 Hebron Field produced about 3½ billion cubic feet. Figures for the entire county in 1933 are not yet available.

In 1932 Potter County ranked 11th among the gas-producing counties of Pennsylvania, the total production of the State in that year being 63,286,242,000 cubic feet from 16,426 wells.

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*From Bureau of Statistics, Department of Internal Affairs.

"Shallow" Gas Pools

The following information on the "shallow" pools of Potter County is from the files of the Geological Survey. The data are incomplete and do not give an adequate picture, but are included here for any usefulness they may possess. The pools* with index numbers are shown by stippled pattern on Figure 2.

(1) Shinglehouse pool produced gas from the Bradford, Balltown, Richburg, and Sheffield sands. The Bradford, the principal producing sand, yielded oil locally. Depth of wells 900 - 1,300 feet. Gas wells had initial production of 25,000 to 500,000 cubic feet and averaged less than 100,000. Rock pressure averaged less than 100 pounds per square inch.

(2) North Fork pool. A few small gas wells.

(3) Roulette pool. Discovered in 1905 and drilled up about 1910. Some wells have been drilled as recently as 1928. Production is gas from the Bradford, Richburg, and Chipmunk sands. Wells are 1,800 to 2,000 feet deep. The best wells start at 1 to 1½ million cubic feet, but the average well settles rapidly to about 200,000 cubic feet. Rock pressure ranges up to 300 pounds per square inch. The gas is wet and has a B.t.u. value of 1150 to 1175.

This pool is on the north flank and southwest plunge of the Hebron dome. On the north production extends well out into the Oswayo syncline. The axis has been productive only on the southwest plunge and only a few small wells have been found on the south flank.

(4) Costello pool. Shallow gas wells. Small.

(5) Germania pool. Shallow gas wells. Small.

STRATIGRAPHY

Columnar Section

The rock formations exposed** at the surface in Potter County are subdivided as follows:

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*Reproduced from the Oil and Gas Field map of Western Penna., issued by Pennsylvania Geol. Survey, 1932. This map shows pools, structure, and pipe lines on the scale 6 miles equals 1 inch and can be purchased from Division of Documents, Department of Property and Supplies, Harrisburg, 25 cents (Stamps not accepted).

**After vol. GGG of the Penna. Second Geol. Survey and Gaines Folio, U.S. Geol. Survey.

	Thickness
Quaternary	
Recent	
Alluvium	
Pleistocene	
Glacial deposits	
Unconformity	
Carboniferous	
Pennsylvanian	
Pottsville formation	0 - 150±
Unconformity	
Mississippian	
Mauch Chunk shale	50±
Pocono ('Oswayo') formation	350 - 650
Devonian	
Catskill red beds (Cattaraugus formation) . . .	350 - 600+
Chemung formation	175+

Rocks not exposed at the surface but encountered in wells are as follows:

	Matteson #1* Hebron Township Ft.	Emporium Lumber Co. #1** East Fork District Ft.
Catskill red beds	56	591
Chemung	2,553	1,867
	(Crandall Hill sand equivalent Bradford sand at 1,290-1,314 ft.)	(Bradford ? sand 2,410-2,446 ft.)
Portage	1,815	2,969
Genesee	199	96
Tully limestone	48	65
Hamilton	532	574
Marcellus		113
Onondaga	27	5
Oriskany (no sand) . . .	5	31
Helderberg	66	
Cobleskill limestone . .	5	
Salina	300+	
	(Interval base of Catskill red beds to Top of Oriskany 5,174 ft.)	(Interval base Catskill red beds to top of Oriskany 5,689 ft.)

* By Charles R. Fettke, Pennsylvania Geol. Survey.

** Courtesy of Allegheny Gas Company.

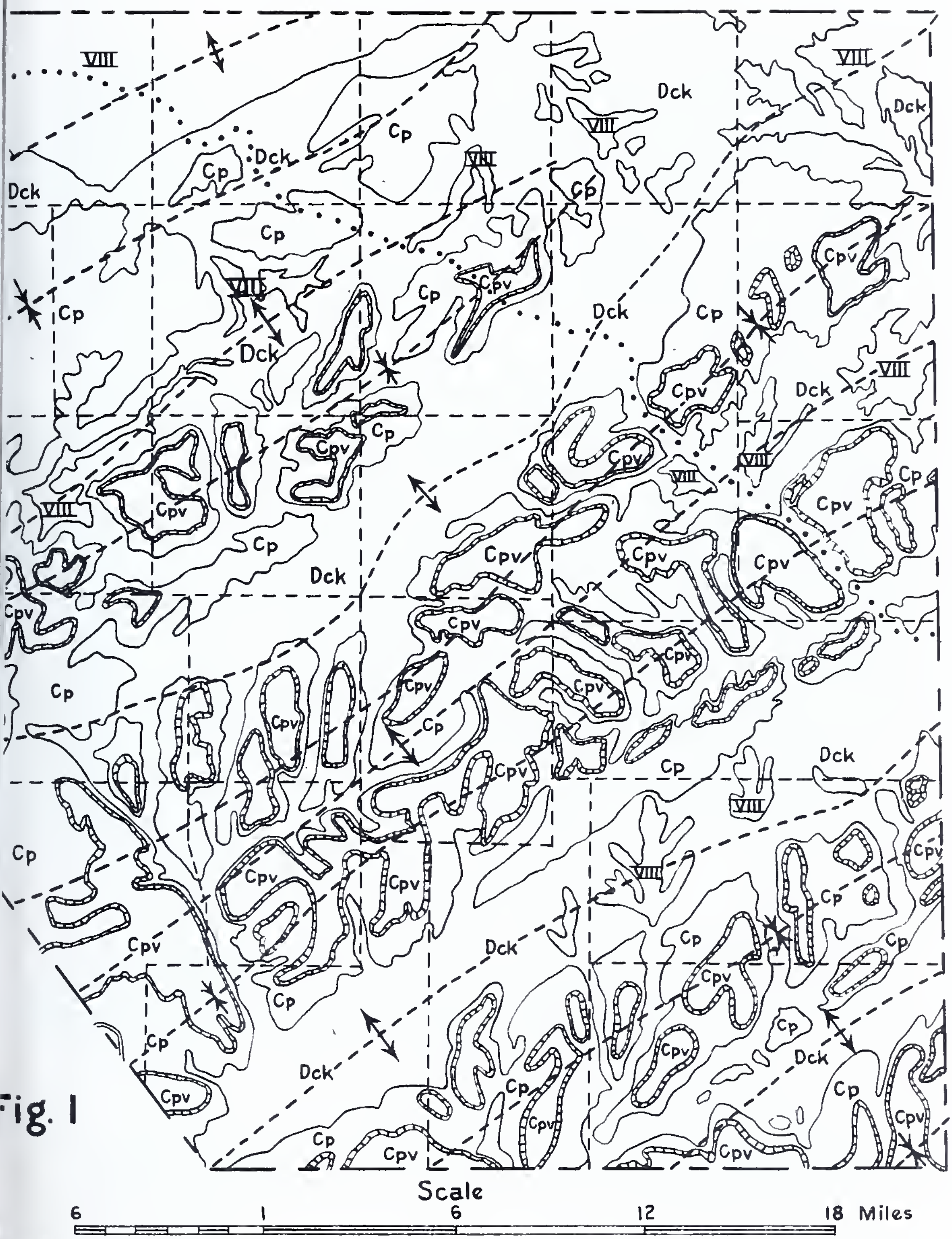

Fig. I

I=Allegheny Cpv=Pottsville ∮=Mauch Chunk Cp=Pocono Dck=Catskill VIII=Chemung

······South limit of glaciation

AREAL GEOLOGY OF POTTER COUNTY

Distribution of Formations

Potter County lies within the Allegheny Plateau Province. The tops of the highest hills are flat and are about of equal elevation (2,500-3,000 feet above sea level), that is, they are remnants of a once continuous, almost level surface that extended throughout and beyond the limits of the county. Streams flowing on this old surface cut valleys into it and destroyed it, so that today the valley bottoms are 500 to 1,000 or more feet below the old surface level. Tributaries to these streams have so dissected the area that it is now looked upon by travelers as a country of rugged mountains that for most part has been given over to forest growth. It is one of the most favored hunting and fishing grounds of the State and attracts large numbers of sportsmen annually.

In general the topography of the county may be classified as a succession of alternating belts of mountain land and valley land that cross the country in about a N.55°E direction; the mountainous belts occur in synclinal areas and are six in number; the valley lands occur in anticlinal areas.

In the synclinal mountains we find the younger rocks of the area exposed, the very youngest rocks capping the highest hills. In the anticlinal valley areas stream erosion has removed the younger rocks and in consequence the oldest rocks that are exposed appear in stream valleys in the vicinity of the anticlinal axes. In general Catskill rocks (locally Chemung rocks) appear at the surface in the anticlinal areas, and Pocono and younger rocks in the synclinal areas.

The distribution of the several formations and the relation of their occurrence to structure is shown in a general way on Figure 1. This map is largely a reproduction of the geologic map prepared by the Pennsylvania Second Geological Survey. Pictorially it is approximately correct. It is in error locally because when made the existence of the Sub-Olean conglomerate in the Pocono formation had not been recognized and as a result Pottsville conglomerate has been mapped on some hilltops where only Pocono occurs.

Description of Exposed Formations

No systematic description of the exposed rocks of Potter County has been published. The following interpretation is based largely upon descriptions of localities included in the Pennsylvania Second Geological Survey publications and on the description of the Gaines quadrangle in the U. S. Geological Survey Folio 92.

Alluvium. Consists chiefly of unconsolidated sand, gravel, and silt deposits in or near present stream channels.

Glacial deposits. Present only in the northeastern part of the county. For the most part they occur locally and often only as a thin veneer.

Pottsville. The Pottsville formation, as previously mentioned, is incorrectly represented on Figure 1. It is definitely known to be present only at the following localities:* In parts of Pike, Jackson, and West Branch townships, where it represents the westward continuation of the Gaines coal basin of Tioga County; in a small are in the southeastern part of Sweden Township and in Eulalia Township i Coudersport basin. It may also cap the highest hilltops in Abbott an Sylvania townships.

A full section of Pottsville in adjacent counties consists o five members as follows: Johnson Run sandstone (top), Alton shales and coal beds (3), Kinzua Creek sandstone, Marshburg shale and coal, Olean conglomerate (base). The thickness of the entire formation commonly is about 200 feet. A complete section is not present at any locality in Potter County. In Pine Creek (Gaines) basin and in the Coudersport basin the Alton coals and shales have been reported; elsewhere only lower members of the formation are believed to be preserve

Coal has been found only in small isolated areas and has not proved to be commercially important.

The most widespread and conspicuous member of the Pottsville is the Olean or Sharon conglomerate which occurs at the base of the formation. It commonly is a massive sandstone that shows a varying content of pebbles and is about 50 feet thick. It is resistant to erosion and is the cliff-forming member of the Pottsville.

Mauch Chunk. The Mauch Chunk formation immediately underlie the massive, resistant, Olean conglomerate that forms the base of the Pottsville and usually is concealed by talus. Commonly it consists o red and other colored shale that in this area probably nowhere exceed 50 feet in thickness. Being soft and thin the formation owes its preservation to the protection of the overlying conglomerate and is pres only where the Olean is present.

Pocono. Pocono here refers to the interval between the Catskill red beds and the Mauch Chunk shale. The character of sedimentation in this interval apparently changes in passing from McKean Count on the west to Tioga County on the east of this area. In northwest McKean County, Ashburner subdivided the Pocono into three units: (1) upper sandstones and shales, (2) Sub-Olean conglomerate, (3) lower shales and sandstones. Working in Roulette, Clara, Hebron, and Sharon townships, northwest Potter County, he recognized these same subdivisions and reported the following section.

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*Volume GGG, p. vii.

	Feet	
Olean conglomerate	50	
Mauch Chunk) Upper Pocono)	70)	
Sub-Olean	60)	Mauch Chunk Pocono 400 ft.
Lower Pocono	270)	
Catskill	370	
Chemung	175+	

The outstanding member of Ashburner's Pocono is the Sub-Olean onglomerate which is conspicuous throughout much of northwest McKean ounty. It is differentiated from the Olean conglomerate chiefly by the hape of the pebbles contained in the two formations. Pebbles from the lean are egg shaped, while those from the Sub-Olean have the shape of flattened orange. The lower and upper Pocono shale and sandstone embers commonly are very similar in lithologic character, consisting or the most part of alternating thin beds of gray and olive flaggy andstone and sandy shale, with some red sandstone and shale.

The Gaines quadrangle included a strip in northeast Potter ounty about 7 miles wide by 17 miles long. As described in the Gaines olio the Pocono interval, here represented by the Oswayo formation, onsists of 1,000 ± feet of heavy beds of green and gray flaggy sandtone with some green and gray shales and local beds of red shale. hin-bedded gray or buff sandstone predominates in the upper 200 feet f the formation.

Mr. Platt in describing the Oleona coal basin (vol. GGG of he Pennsylvania Second Geol. Survey) refers to the Pocono in Abbott ownship as being 650± feet thick and consisting for the most part f sandstones, massive and shaly, green-gray and red.

No other descriptions are available for the Pocono of this ounty.

Mr. Ashburner in his discussion of the Pocono in McKean ounty remarks that the three-fold division of the formation does ot seem to hold southeast of a line drawn through Ridgway, Elk ounty and Norwich, McKean County. If this line were extended it ould enter Potter County at the southwest corner of Roulette Township and leave the county at the northeast corner of Genesee Township. Mr. Ashburner recognized the three-fold division northwest f this line in Potter County and from the information available it ould seem that throughout the rest of Potter County the Oswayo ype of sedimentation may prevail. The Oswayo in its typical developpment is transitional into the Catskill, the line commonly being rawn where red ceases to be the dominant color.

Catskill red beds. The name Catskill as used here is applied to a series of sandstones and shales that are chiefly fresh water in origin and are dominantly red. Interbedded with the red beds are beds of shale and sandstone that are gray, green, or olive in color.

The Catskill is transitional into the Pocono (Oswayo) above and into the Chemung below — both boundaries are therefore rather arbitrary lines. Also, the base of these red beds does not represent a definite stratigraphic horizon throughout Pennsylvania. Deposition of the red beds began in eastern Pennsylvania in Portage* time, while in Potter County it did not begin before late in Chemung time.

Its red color permits this formation to be recognized readily both in the field and in well cuttings and as a result, in the absence of a better marker, the base of the red beds has become quite generally used as a reference horizon. While of considerable value locally, its use as a horizon marker obviously should not be extended over any considerable area.

Structure contour maps are being made in this region by walking along the outcrop of beds. Several conglomerates that occur near the base of the red beds are said to have proved especially usable in this work.

In northwest Potter County the Catskill is 350 feet thick, in northeast Potter County the Cattaraugus (Catskill) red beds are 500± feet thick; the Emporium Lumber Company well, East Fork District, reports 590 feet of Catskill and does not specify a complete section.

Chemung. The Chemung commonly consists of a succession of thin-bedded, gray sandstones and shales in about equal proportion and includes beds of gray limestone and limy shale that frequently are fossiliferous. As noted above the Chemung is transitional into the Catskill and its top may therefore include some beds of red color.

The Unexposed Formations

The lithology of the unexposed formations is given in detail in the following geologic logs. The log of the Matteson well was prepared for the Pennsylvania Geological Survey by C. R. Fettke; the log of the Emporium Lumber Company well is published by courtesy of the Allegheny Gas Company.

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* Willard, B., Bull. Geol. Soc. Am., vol. 44, pp. 495-516, 1933.

Record of J. W. Matteson No. 1 Well

Description of Strata	Depth Top	Depth Bottom
Top of Chemung group	56	
No samples collected	0	630
Greenish-gray sandy shale	630	632
Very fine-grained light greenish-gray sandstone - slightly calcareous	632	659
Greenish-gray shale	659	675
Very fine-grained greenish-gray sandstone - slightly calcareous	675	698
Dark greenish-gray sandy shale	698	708
Gray shale	708	730
Fine-grained light greenish-gray sandstone - slightly calcareous	730	736
Gray shale with a little interbedded dark greenish-gray fossiliferous sandy shale	736	830
Very fine-grained light gray sandstone - somewhat calcareous and very fossiliferous	830	836
Gray shale - fossiliferous	836	848
Very fine-grained light brownish-gray sandstone- somewhat calcareous and fossiliferous	848	855
Greenish-gray shale	855	863
Fine-grained light brownish-gray sandstone - somewhat calcareous and fossiliferous	863	892
Greenish-gray shale	892	921
Greenish-gray sandy shale - somewhat calcareous and very fossiliferous	921	960
Gray to dark gray shale with a little interbedded fine-grained light greenish-gray fossiliferous sandstone	960	1095
Greenish-gray sandy shale - fossiliferous	1095	1110
Fine-grained dark grayish-brown sandstone - somewhat calcareous and fossiliferous	1110	1112
Greenish-gray shale	1112	1136
Fine-grained light grayish-brown sandstone - slightly calcareous and fossiliferous - with some interbedded shale	1136	1154
Greenish-gray shale - in part fossiliferous	1154	1242
Dary gray shale	1242	1290
Fine-grained chocolate-brown sandstone - with considerable interbedded greenish-gray shale (Crandall Hill sand)	1290	1314
Greenish-gray shale with some interbedded fine-grained chocolate-brown sandstone	1314	1330
Greenish-gray shale	1330	1506
Very fine-grained, light grayish-brown sandstone with some interbedded greenish-gray shale	1506	1525
Gray shale	1525	1534
Very fine-grained chocolate-brown sandstone - slightly calcareous	1534	1540

Greenish-gray shale	1540	1548
Dark gray sandy shale	1548	1556
Very fine-grained dark chocolate-brown sandstone	1556	1562
Dark gray sandy shale with a little interbedded gray shale	1562	1616
Dark gray shale with some interbedded greenish-gray sandy shale	1616	1690
Very fine-grained grayish-brown sandstone	1690	1698
Greenish-gray sandy shale	1698	1812
Dark gray sandy shale	1812	1890
Dark gray shale	1890	1956
Grayish-black shale	1956	1962
Very dark gray shale	1962	1973
Dark greenish-gray sandy shale	1973	2095
Very fine-grained light gray sandstone - slightly calcareous	2095	2101
Dark grayish-brown sandy shale	2101	2108
Dark gray sandy shale	2108	2140
Dary gray shale	2140	2162
Dark grayish-brown sandy shale	2162	2169
Dary gray shale	2169	2200
Very dark gray shale	2200	2222
Grayish-black shale	2222	2232
Very fine-grained grayish-brown sandstone	2232	2240
Very dark gray shale	2240	2247
Grayish-brown sandy shale	2247	2251
Greenish-gray sandy shale	2251	2270
Brownish-gray sandy shale	2270	2280
Dark greenish-gray sandy shale	2280	2350
Very dark grayish-brown sandy shale	2350	2379
Gray shale	2379	2389
Very fine-grained dark grayish-brown sandstone	2389	2408
Dark grayish-brown sandy shale	2408	2418
Very fine-grained dark grayish-brown sandstone - slightly calcareous	2418	2446
Dark greenish-gray sandy shale	2446	2510
Very fine-grained dark grayish-brown sandstone	2510	2528
Greenish-gray sandy shale	2528	2545
Very fine-grained greenish-gray sandstone - slightly calcareous	2545	2553
Bottom of Chemung group		2553
Dark greenish-gray sandy shale	2553	2604
Grayish-black shale	2604	2606
Very dark grayish-brown sandy shale containing plant fragments	2606	2614
Gray to dark gray sandy shale	2614	2665
Grayish-black shale	2665	2675
Dark gray shale	2675	2708
Very dark gray shale	2708	2718
Greenish-gray sandy shale	2718	2736
Dark grayish-brown sandy shale	2736	2752

Dark gray sandy shale	2752	2774
Very fine-grained very dark brownish-gray sandstone	2774	2784
Dark gray sandy shale	2784	2990
Dark grayish-brown sandy shale	2990	3007
Dark gray shale with some interbedded greenish-gray sandy shale	3007	3055
Very fine-grained greenish-gray sandstone	3055	3061
Very fine-grained dark brownish-gray sandstone	3061	3081
Greenish-gray to dark gray shale	3081	3091
Very fine-grained very dark brownish-gray sandstone	3091	3099
Gray to dark gray shale	3099	3139
Dark gray sandy shale with some interbedded dark gray shale	3139	3182
Very fine-grained dark greenish-gray and grayish-brown sandstone - slightly calcareous	3182	3189
Dark gray sandy shale	3189	3265
Dark gray shale	3265	3345
Dark gray sandy shale	3345	3363
Dary gray shale	3363	3398
Grayish-black shale	3398	3408
Dark greenish-gray sandy shale with some interbedded dark gray shale	3408	3501
Dark gray shale	3501	3513
Very fine-grained dark greenish and brownish-gray. sandstone	3513	3518
Dark gray shale	3518	3528
Very fine-grained very dark greenish-gray sandstone with some interbedded very dark gray shale	3528	3546
Very fine-grained dark greenish and brownish-gray sandstone	3546	3565
Dark to very dark gray shale	3565	3621
Very fine-grained dark greenish-gray sandstone with some interbedded dark gray shale	3621	3640
Dark to very dark gray shale	3640	3818
Grayish-black shale	3818	3845
Dark to very dark gray shale	3845	4025
Grayish-black shale	4025	4034
Dark gray shale	4034	4045
Grayish-black shale with some interbedded dark gray shale	4045	4095
Very dark gray shale	4095	4103
Black shale	4103	4125
Grayish-black shale with some interbedded dark gray shale	4125	4220
Very dark gray shale	4220	4275
Very dark gray shale - slightly calcareous	4275	4345
Grayish-black shale - slightly calcareous	4345	4367
Very fine, dense, very dark brownish-gray fossiliferous limestone (Genundewa)	4367	4368
Bottom of Portage group		4368
Grayish-black shale - somewhat calcareous	4368	4410
Grayish-black shale - slightly calcareous	4410	4435
Grayish-black shale	4435	4506
Grayish-black shale - slightly calcareous	4506	4567
Bottom of Genesee black shale		4567

Very fine, dense, dark brownish-gray argillaceous limestone with some interbedded grayish-black calcareous shale	4567	4585
Very fine, dense, dark brownish-gray argillaceous limestone	4585	4615
Bottom of Tully limestone		4615
Very dark gray shale - somewhat calcareous	4615	4625
Grayish-black shale - slightly calcareous	4625	4650
Very dark gray shale	4650	4656
Grayish-black shale	4656	4676
Grayish-black shale - somewhat calcareous	4676	4685
Very dark gray shale - somewhat calcareous	4685	4695
Very dark gray shale	4695	4705
Grayish-black shale - slightly calcareous	4705	4735
Very dark gray shale - somewhat calcareous	4735	4769
Very dark gray shale - slightly calcareous	4769	4810
Grayish-black shale - slightly calcareous	4810	4817
Very dark gray shale	4817	4830
Grayish-black shale	4830	4835
Very dark gray shale - slightly calcareous	4835	4860
Grayish-black shale - slightly calcareous	4860	4870
Very dark gray shale - slightly calcareous	4870	4945
Grayish-black shale - somewhat calcareous	4945	4965
Very dark gray shale - slightly calcareous	4965	4984
Very dark gray shale - calcareous	4984	4992
Grayish-black shale - calcareous	4992	5000
Very dark gray shale - calcareous	5000	5035
Grayish-black shale - calcareous	5035	5053
Black shale - somewhat calcareous	5053	5101
Black shale - slightly calcareous	5101	5147
Bottom of Hamilton group		5147
Very fine, crystalline, light to dark gray limestone	5147	5159
Very fine, dense, brownish-gray cherty limestone	5159	5174
Bottom of Onondaga limestone		5174
Very fine, crystalline, dark brownish-gray cherty limestone with occasional well-rounded fine to medium-sized quartz grains	5174	5179
Bottom of Oriskany horizon		5179
Very fine, crystalline, very dark brownish-gray siliceous limestone	5179	5245
Bottom of Helderberg limestone		5245
Very fine, dense, very dark gray limestone (Cobleskill)	5245	5250
Top of Salina group	5250	
Very fine, dense, gray argillaceous and siliceous dolomitic limestone	5250	5274
Very fine, dense, very dark brownish-gray argillaceous and siliceous dolomitic limestone	5274	5312
Bottom of Bertie water line		5312
Very fine, dense, very dark brownish-gray argillaceous dolomitic limestone containing some anhydrite	5312	5400
Gray calcareous shale containing a little anhydrite	5400	5407
Very fine, dense, dark brownish-gray argillaceous dolomitic limestone	5407	5442

Dark gray shale - somewhat calcareous	5442	5447
Very fine, dense, dark brownish-gray argillaceous dolomitic limestone containing some anhydrite	5447	5528
Medium-grained, crystalline, light gray salt	5528	5533
Very fine, dense dark brownish-gray argillaceous dolomitic-limestone	5533	5540
Medium-grained, crystalline, light gray salt	5540	5550
Well stopped in Camillus formation at a total depth of		5550

Record of Emporium Lumber Company Well #1154

	Depth	
Description of Strata	Top	Bottom
Surface CATSKILL FORMATION	0	25
Greenish-gray, fine to medium-grained micaceous sand	25	40
Sand grains well rounded - magnetite?		
Greenish-gray, fine-grained micaceous sand	40	55
Greenish-red sandy shale	55	60
Red sandy shale	60	65
Red and green sandy shale - minor amount mica	65	76
Greenish-red, medium-grained micaceous sand	76	82
Greenish-gray, medium-grained micaceous sand	82	87
Grains well rounded and sorted, minor amount heavy minerals		
Red medium-grained micaceous - similar to above	87	92
Red fine to medium-grained micaceous sand	92	98
Greenish-gray, medium-grained sand and sandy shale	98	104
Greenish-gray, micaceous sandy shale and shale	104	115
Greenish-gray, medium-grained sand and sandy shale	115	120
Sand grains rounded, sorted; minor amount heavy minerals		
Gray, medium-grained micaceous sand and a little interbedded sandy shale	120	131
Gray, fine to medium-grained sand and sandy shale - minor amount of pyrite	131	140
Red sandy shale - a little interbedded reddish sand	140	145
Red fine-grained micaceous sand	145	156
Greenish-gray medium-grained micaceous sand minor amount heavy minerals	156	174
Greenish-gray, fine -to medium-grained micaceous sand	174	180
Greenish-gray, medium-grained sand and hard shaly sand	180	196
Red pyrite shale - minor amount red sand	196	202
Red sandy shale and micaceous sand	202	214
Reddish gray fine-grained micaceous sand	214	256
Greenish red medium-grained sand grains, well rounded and sorted	256	268
No samples		
Greenish gray fine to medium-grained micaceous sand with a little interbedded sandy shale	275	280

Red (with a greenish cast) fine to medium-grained sand	280	286
Red and green fine to medium-grained sand and red micaceous sandy shale	286	292
Red micaceous sandy shale and fine-grained red sand	292	298
Red fine-grained sand-grains well rounded	298	309
Red fine-grained sand and interbedded red micaceous sandy shale	309	321
Red and green fine-grained sand - grains well rounded	321	333
Red (with some white) fine-grained sand	333	340
Red fine-grained sand and interbedded red micaceous sandy shale	340	364
Red fine-grained sand - grains are well rounded	364	369
Red and green fine-grained sand and sandy shale	369	373
Reddish white fine-grained sand	373	384
Red shale	384	392
Red fine-grained sand	392	401
Reddish-white fine-grained sand - grains well rounded	401	418
Red shale and greenish gray fine-grained sand	418	431
Red and green sandy shale	431	443
Greenish-gray,fine-grained sand and red sandy shale	443	456
Greenish-gray to red fine-grained sand	456	473
Red and green micaceous sandy shale	473	492
White to greenish-gray fine-to medium-grained sand minor amounts heavy minerals	492	515
Red, fine-to medium-grained sand, interbedded red sandy shale	515	524
Fine-grained reddish sand	524	530
Interbedded, red sandy shale and greenish-gray fine-grained micaceous sand	530	549
Red, fine-grained sand	549	555
Greenish-gray, fine-to medium-grained sand and green sandy shale	555	561
Greenish-gray, fine-grained sand	561	567
Interbedded, red sandy shale and red and green fine-grained sand	567	579
Red and green sandy shale	579	591

CHEMUNG FORMATION

Greenish-gray, fine-to medium-grained sand, grains well rounded, minor amount heavy minerals	591	597
Greenish-gray sandy shale and green fine-grained sand	597	603
Greenish-gray sandy shale and sand - small amount of purple sandy shale	603	609
Greenish-gray micaceous sandy shale and interbedded fine-grained sand with a little chocolate shale	609	617
Gray splintery shale	617	623
Gray shale and interbedded fine-grained gray sand	623	636
Gray, sandy shale and fine-grained gray sand minor amount of pyrite	636	646
Light gray, fine-grained sand - slightly calcareous minor amount pyrite	646	652
Interbedded light gray	652	660

Slightly calcareous gray shale	660	672
Fine-grained, gray, micaceous sand	672	678
Greenish-gray shale	678	682
Greenish -gray, fine-grained sand with a few coarse rusty grains	682	688
Interbedded greenish-gray, shale and fine-grained sand	688	708
Greenish-gray sand	708	720
Greenish-gray shale	720	726
Interbedded greenish-gray shale and fine-grained, gray sand	726	737
Fine-grained, gray sand	737	743
Interbedded, greenish-gray, fine-grained sand, gray shale and chocolate sandy shale	743	755
Interbedded, greenish-gray, fine-grained sand, and dark gray to gray sandy shale	755	774
Interbedded,greenish-gray, fine-grained sand and greenish-gray sandy shale	774	790
Greenish-gray, fine-grained sand, greenish-gray shale and chocolate sandy shale	790	796
Red shale, greenish-gray shale, and gray, fine-grained sand	796	813
Greenish-gray shale	813	828
Gray, fine-grained sand grains well rounded	828	842
Interbedded, fine-grained gray sand and greenish-gray shale	842	860
Greenish-gray shale - minor amount gray sand	860	878
Light gray, fine-grained sand	878	897
Fine-grained sand	897	903
Red and green shale	903	929
Greenish-gray, fine-grained sand	929	950
Gray sandy shale	950	958
Interbedded gray shale and fine-grained gray sand	958	982
Fine-grained gray sand	982	988
Interbedded, fine-grained gray sand and gray sandy shale	988	1000
Fine-grained, gray sand	1000	1006
Interbedded, fine-grained gray sand and gray sandy shale	1006	1024
Gray shale	1024	1036
Gray shale and interbedded, fine-grained gray sand	1036	1048
Fine-grained, gray sand - a little interbedded splintery gray shale	1048	1060
Gray shale	1060	1073
Red and greenish-gray shale - a little fine-grained gray sand	1073	1080
Gray shale and interbedded fine-grained gray sand	1080	1086
Fine-grained gray sand and interbedded gray shale	1086	1098
Fine-grained, dark gray sand and interbedded dark gray splintery shale	1098	1110
Interbedded,greenish-gray shale and fine-grained reddish sand	1110	1129
Greenish-gray shale	1129	1134
Greenish-gray, fine-grained sand	1134	1141
Gray shale - a little fine-grained gray sand	1141	1153

L311337

Fine-to medium-grained gray sand - show of gas at top. Coarse sub-angular grains of sand at base	1153	1177
Interbedded gray shale and fine-grained, gray sand	1177	1189
Gray shale	1189	1213
Gray shale and interbedded fine-grained, gray sand	1213	1251
Fossiliferous gray shale - minor amount calcite	1251	1264
Fine-grained gray sand	1264	1307
Gray shale	1307	1320
Interbedded gray shale and fine-grained gray sand	1320	1344
Fine-grained gray sand	1344	1360
Gray shale	1360	1400
Gray shale and interbedded hard,fine-grained gray sand	1400	1412
Gray shale	1412	1424
Gray shale and interbedded hard,fine-grained sand	1424	1430
Gray shale, fossiliferous near the base	1430	1503
Gray shale and interbedded, fine-grained, gray sand	1503	1509
Gray shale	1509	1702
Calcareous gray shale	1702	1776
Calcareous gray shale	1776	1826
Gray sandy shale	1826	1988
Very fine-grained, hard, gray sand and gray sandy shale	1988	2006
Gray sandy shale	2006	2102
Fine-grained, gray sand	2102	2108
Gray, calcareous sandy shale	2108	2114
Gray shale	2114	2120
Gray, calcareous sandy shale	2120	2130
Gray sandy shale	2130	2142
Gray, calcareous sandy shale	2142	2154
Gray shale	2154	2190
Calcareous gray shale	2190	2196
Gray shale - minor amount pyrite	2196	2208
Hard, gray, fine-grained calcareous sand fossiliferous	2208	2288
Hard, gray, fine-grained sand and interbedded gray sandy shale	2288	2300
Hard, gray, fine-grained calcareous sand	2300	2306
Gray sandy shale	2306	2312
Fine-grained, gray, calcareous sand and sandy shale	2312	2318
Gray sandy shale	2318	2336
Gray sandy shale and interbedded fine-grained gray sand	2336	2366
Gray sandy shale - fossiliferous at 2400	2366	2410
Gray sandy shale, fine-grained gray sand Bradford?	2410	2446
Gray sandy shale	2446	2458

PORTAGE FORMATION

Gray, calcareous sandy shale	2458	2464
Interbedded,fine-grained, gray sand and gray sandy shale	2464	2482
Gray calcareous sandy shale	2482	2512
Gray sandy shale	2512	2518
Gray sandy shale and gray-white limestone	2518	2542
No samples 2542 - 2900		
Gray shale and sandy gray shale	2900	2912
Gray to chocolate shale - minor amount calcite	2912	2918
Gray to dark gray sandy shale	2918	2924
Gray shale	2924	2930

Gray to chocolate shale	2930	2936
Gray shale and sandy shale	2936	2954
Gray, fine-grained calcareous sand	2954	2960
Gray shale	2960	3012
Gray sandy shale	3012	3044
Gray sandy shale and interbedded, fine-grained gray calcareous sand	3044	3068
Gray sandy shale	3068	3086
Gray sandy shale and interbedded, fine-grained gray sand	3086	3122
Fossiliferous gray sandy shale	3122	3128
Gray sandy shale and interbedded, fine-grained, gray sand	3128	3168
Gray and chocolate shale and fine-grained, gray sand	3168	3174
Gray shale and interbedded light gray, fine-grained sand	3174	3186
Gray sandy shale	3186	3198
Gray shale	3198	3204
Fine-grained, gray sand	3204	3210
Gray shale	3210	3228
Gray shale and gray sandy shale	3228	3240
Gray shale and interbedded, fine-grained, gray sand	3240	3270
Gray shale minor amount calcite	3270	3324
Gray shale and interbedded, fine-grained, gray sand	3324	3378
Gray shale	3378	3402
Gray shale and interbedded, dark gray, fine-grained sand	3402	3418
Gray shale and sandy shale	3418	3436
Gray shale and interbedded, fine-grained, gray sand	3436	3476
Gray sandy shale and gray shale	3476	3488
Gray shale and interbedded, fine-grained, gray sand	3488	3518
Gray shale minor amount interbedded, fine-grained, gray sand	3518	3716
Gray shale and interbedded, light gray, fine-grained sand	3716	3740
Hard, gray shale	3740	3746
Gray shale and interbedded, fine-grained, gray sand	3746	3800
Gray shale	3800	3844
Gray sandy shale	3844	3854
Grayish-black, fine- grained sand	3854	3860
Gray to dark gray shale and interbedded, fine-grained sand	3860	4004
Very fine-grained, light gray sand and very hard minor amount mica	4004	4020
Gray to dark gray shale, sandy shale and minor amount interbedded, fine-grained, gray sand	4020	4130
Gray, fine-grained sand, darker gray at base	4130	4163
Gray to dark gray shale minor amount interbedded, fine-grained sand	4163	4230
Fine-grained, gray sand	4230	4258
Gray shale	4258	4288
Dark, gray, fine-grained sand	4288	4299
Gray shale	4299	4325
Dark gray, fine-grained sand	4325	4340
Gray shale, brownish when wet	4340	4361
Gray shale and gray sandy shale	4361	4370
Grayish black shale and interbedded, fine-grained, gray sand	4370	4382

Hard gray shale	4382	4399
Very fine-grained, dark gray sand	4399	4405
Dark gray shale	4405	4434
Gray sandy shale	4434	4439
Fine-grained, dark gray sandy and dark shale	4439	4443
Gray shale and sandy shale	4443	4449
Dark gray shale	4449	4455
Fine-grained, gray sand	4455	4462
Gray shale	4462	4475
Dark gray, black shale and very fine-grained,gray sand	4475	4480
Gray shale and gray sandy shale	4480	4515
Calcareous gray shale	4515	4521
Black shale and calcareous fine-grained, gray sand	4521	4532
Gray sandy shale	4532	4537
Slightly calcareous gray, micaceous sandy shale	4537	4542
Slightly calcareous fine-grained gray sand	4542	4550
Slightly calcareous gray shale and sandy shale	4550	4570
Grayish-black shale minor amount limestone	4570	4576
Gray to dark gray shale and sandy shale slightly calcareous	4576	4736
Hard gray pyritic very slightly calcareous shale - minor amount soft light colored calcareous shale	4736	4747
Hard gray shale and sandy shale	4747	4826
Hard dark gray shale	4826	4922
Hard gray, slightly calcareous shale	4922	4945
Gray shale and slightly calcareous shale minor amount impure limestone	4945	4951
Grayish black shale and lighter gray calcareous shale	4951	4960
Slightly calcareous shale	4960	5007
Calcareous dark gray shale, brownish when wet	5007	5023
Slightly calcareous dark gray shale	5023	5103
Very calcareous dark gray shale	5103	5110
Calcareous dark gray shale, minor amount light gray limestone	5110	5117
Calcareous dark gray shale	5117	5127
Very calcareous dark grayish black shale	5127	5150
Slightly calcareous dark gray shale	5150	5182
Very calcareous grayish black shale	5182	5192
Slightly calcareous gray shale	5192	5197
Light gray pyriferous calcareous shale	5197	5203
Calcareous gray to black shale	5203	5219
Shaly dark gray limestone	5219	5230
Slightly calcareous gray shale	5230	5259
Calcareous grayish black shale, minor amount calcite veining	5259	5270
Calcareous gray to grayish-black shale - pyritic	5270	5305
Slightly calcareous gray shale pyritic	5305	5319
Calcareous dark gray shale	5319	5331
Slightly calcareous gray shale	5331	5386
Very calcareous gray shale	5386	5411
Very calcareous grayish black shale	5411	5427

GENESEE SHALE

Slightly calcareous grayish-black shale	5427	5437

alcareous brownish gray shale	5437	5444
lightly calcareous grayish-black shale	5444	5460
lightly calcareous pyriferous black shale	5460	5509
alcareous pyriferous black shale - minor amount free calcite	5509	5523

TULLY LIME

ray lime contains pyrite	5523	5527
ray lime	5527	5531
ery calcareous black shale	5531	5535
ray lime note: presence of black shale and pyrite probably due to caving	5535	5555
yriferous gray lime	5555	5567
ray lime with a minor amount of calcite	5567	5584
ray lime with a minor amount of calcite and pyrite	5584	5588

HAMILTON GROUP

Dark gray calcareous shale minor amount pyrite	5588	5677
Slightly calcareous gray shale	5677	5775
Calcareous gray shale	5775	5806
Calcareous brownish shale	5806	5811
Calcareous gray shale	5811	5855
Calcareous gray shale showing calcite veining	5855	5857
Calcareous gray shale and calcite	5857	5956
Slightly calcareous gray shale and calcite	5956	6046
Calcareous gray shale calcite veining 6100-6110	6046	6118
Calcareous gray shale and calcite	6118	6162

MARCELLUS SHALE

Slightly calcareous black shale minor amount pyrite	6162	6207
Slightly calcareous black shale, calcite veining	6207	6221
Slightly calcareous black shale - minor amounts of pyrite and calcite	6221	6267
Very calcareous pyriferous black shale	6267	6275

ONONDAGA LIME

Dark gray limestone	6275	6280

ORISKANY SAND

Very slight traces glauconite from 6280 - 6283		
Dark gray lime, minor amount pyrite, coarse grains of sand and quartzitic sand. Sand grains are well rounded to sub-angular, frosted, cemented with lime	6280	6293
75 per cent coarse-grained sand, minor amount quartzitic sand grains, well rounded 25% gray limestone	6293	6295
50 per cent fine to coarse-grained sand and 50 per cent grayish-black limestone	6295	6297
60 per cent coarse-grained sand and 40 per cent grayish-black limestone	6297	6302
Grayish black sandy limestone	6302	6303
Medium-to coarse-graine white sand grains, well rounded cemented with lime. percentage of lime increases toward the base	6303	6311

HELDERBERG LIME

Gray sandy limestone	6311	6320
Gray limestone	6320	6321
Very calcareous gray shale	6321	6331
Dary gray impure limestone	6331	6355
Dark gray limestone - minor amount of light gray lime, calcite and chert	6355	6373
Dark gray cherty limestone - minor amount light gray lime	6373	6385
Dark gray cherty impure limestone with a few very fine rounded grains of sand	6385	6388
Dark gray cherty impure limestone	6388	6396
Dark gray cherty impure limestone - minor amount light gray lime. A few very fine well rounded grains sand	6396	6398
Light, and dark gray cherty impure limestone and oolitic chert	6398	6399
White limestone - minor amount dark gray impure limestone	6399	6407
Dark gray impure limestone - minor amount light gray limestone	6407	6425

STRUCTURE

Six anticlines cross Potter County in a N.55°E direction. (Fig. 2)* They and the adjacent synclines named from northwest to southeast are as follows:

Ceres (Ormsby) syncline
Smethport (Sharon) anticline
Oswayo syncline
Hebron (Roulette-Bingham) anticline
Coudersport syncline
Harrison(Ulysses-Homer) anticline
Cowanesque syncline
Sabinsville(Chatham-Farmington) anticline
Pine Creek (Caldeonia-Cameron) syncline
Cross Fork anticline (Local)
Marshlands (New Bergen) anticline
Kettle Creek syncline
Wellsboro (Stewardson) anticline
Blossburg syncline

In general, regional plunge is southwest, intensity of folding decreases from southeast to northwest, and folds are asymmetric with slightly steepened southeast limbs. The most striking quality of the structures is their parallelism. The Smethport in this area is a relatively broad flat fold; all the others are well defined features having maximum dips of 5 or 6 degrees.

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*Structure mapped by M. N. Shaffner, Pennsylvania Geol. Survey, 1931. Revisited by Mr. Shaffner and the writer in 1932.

Smethport anticline. The position of the Smethport axis is well fixed by surface data just north of the Pennsylvania line, but in this county and for a considerable distance into McKean County surface data are so few and of such poor quality that the position of the axis is only approximately defined. The fold, however, is relatively broad and flat here and as this type of fold permits greater leeway in selecting well locations than does a narrow crested, steep-limbed fold, it is not imperative that the exact location of the axis be known.

In general the axis plunges southwest. This plunge is shown very clearly by strike and dip data in New York State just north of the State line and is suggested by data throughout Sharon Township. In northeast Oswayo Township data are especially few and poor, but here there is some indication of a northeast plunge. It would seem therefore that there may be closure or perhaps only a terrace developed along the axis between Kibbeville and the New York State line.

The Smethport is the most northwesterly of the continuous parallel folds that characterize the eastern edge of the Allegheny Plateau. Northwest of the Smethport anticline the dominant structure is the warped surface which is characterized by low dips and short echelon axes arranged without especial emphasis on parallelism. The Smethport anticline may therefore be expected to partake somewhat of the characteristics of the warped area to which it is adjacent, that is, the axis that we represent as being continuous may in fact be made up of shorter axes arranged en echelon and showing slight closure and the flanks of the fold may show pronounced structural noses and terraces. Terracing on the north flank is clearly indicated by an exposure in New York State northeast of Kibbeville, but in general the reconnaissance data available are not competent to show in detail the form of this structure.

Hebron anticline. The position of the axis of the Hebron anticline is fairly well controlled by surface data. From the vicinity of Roulette it seems to follow an almost direct course N.55°E. to near the east line of Hebron Township, where it bears somewhat more east until it is lost track of in the vicinity of West Bingham, Bingham Township. North of West Bingham the structure appears to be a northwest-dipping monocline, but the data available are indicational rather than conclusive.

A dome exists in Hebron Township. Surface data do not permit it an accurate graphic picture of the dome but by observing the elevation of the base of the Catskill red beds on Allegheny River, Fishing Creek, and South Branch of Whitney Creek where those streams cut into the Chemung at the axis it is possible to get some idea of the axial profile.

The elevation of the base of the Catskill red beds at Roulette (by graphic reconstruction) is about 1,600 feet, in southwest Hebron Township 2,110 feet and west of Palmatier 2,070 feet.

As only red beds are exposed northeast of Palmatier, the northeast plunge cannot be determined by this method. The base of the red beds, while not a sufficiently definite horizon to be used with accuracy throughout a large area, is believed to have some value when its use is restricted to a small area such as this. An axial profile based upon the data available would show a high extending from near the east line to the southwest corner of Hebron Township, a distance of about 6 miles, and an axial plunge of about 500 feet between the southwest corner of the township and Roulette, a distance of about 4 miles. The amount of northeast plunge is in doubt, but the figures quoted would show some closure. Commonly in this region where in general axes plunge southwest, the northeast plunge is appreciably less than the southwest plunge; it may in this instance amount to little more than a terrace effect without notable reversal, for northeast of Palmatier there is some indication that the axial plunge again is southwest.

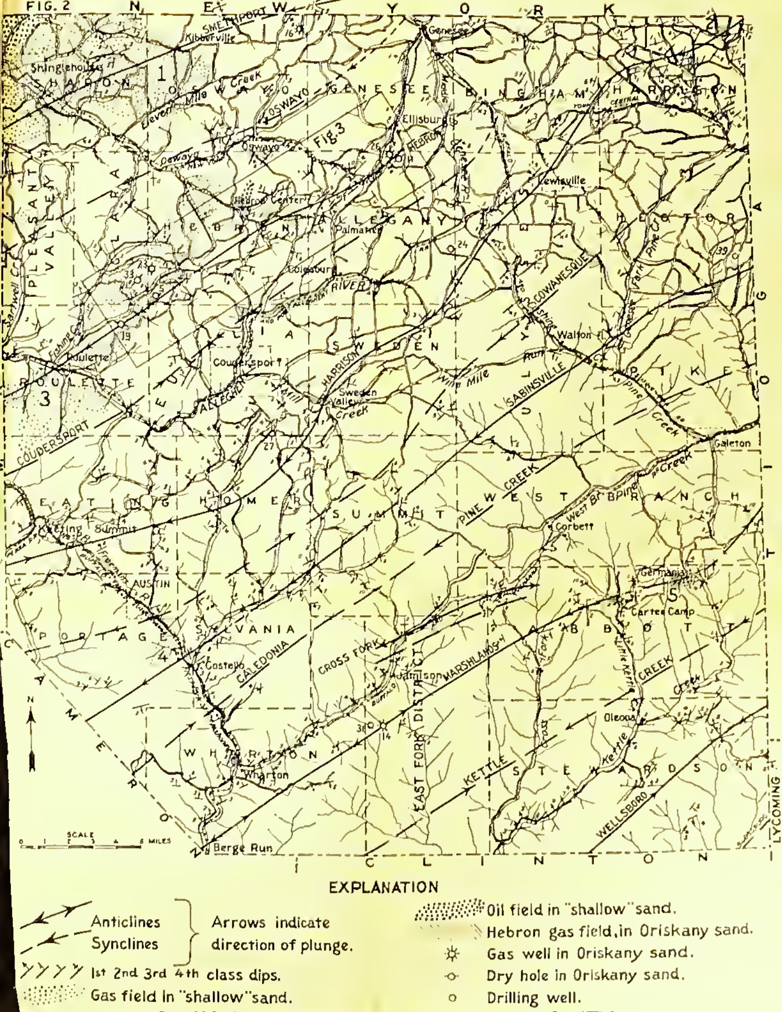
Like most of the Allegheny Front folds that have been mapped, the Hebron shows a steepened south limb. The south limb is faulted.

Surface evidence of faulting was observed at Palmatier and south of Hebron Center. At Palmatier the evidence consists of a belt of steep-dipping to vertical beds that in the farther east exposure is about 20 feet wide. Southeast of Hebron fossiliferous Chemung beds outcrop between Catskill rocks. If the three localities are representative of the same fault line, then the surface trace of the break is about half a mile south of and parallel to the axis. No detail of the probable displacement could be worked out from surface evidence.

Attention should be called to what might be a departure of this fold from the orthodox. In a majority of instances where the dying out of a fold has been observed in this region, the dip of the relatively flat northwest limb has gradually diminished, passed into a terrace and disappeared; the steeper southeast limb has persisted and merged with the southeast dipping limb of a syncline. Obviously this is the simpliest method of eliminating one of a series of close spaced, parallel, asymmetric anticlines that have steepened southeast limbs. Here, however, the gentler north dip prevails and the stronger south dip is absorbed. The full significance of this anomolous behavior will not be understood until detailed studies have been made in the area about West Bingham. It may be only an expression of the faulted south limb. Even so, in this region of meager surface indications where structure is an important factor in Oriskany development, an understanding of the condition may prove of use in interpreting structure elsewhere.

Harrison anticline. The axis of the Harrison anticline enters Potter County in southwest Keating Township and, following a

FIG. 2



STRUCTURAL GEOLOGY OF POTTER COUNTY

omewhat sinuous course, passes out of the county at its northeast orner.

In southwest Keating Township the axis plunges northeast, eversing direction about the middle of the township. This marks he northeast extent of a dome that is quite prominent in southeast cKean and northern Cameron counties. The southwest plunge continues o north of Sweden Valley where a northeast plunge again is noted, ndicating a dome in the northeast part of Homer and southwest part f Sweden townships. Throughout Ulysses, Bingham, and Harrison townhips strike and dip data locally are few and everywhere are of poor uality. Apparently, however, there is a broad flat dome southwest f Lewisville. The steepened southwest plunge of this structure is lear enough but the indications of closure on the northeast are not trong. Northeast closure, if present, no doubt is less than southwest closure and may amount to little more than terracing.

Sabinsville anticline. The axis of the Sabinsville anticline enters the county in southeast Hector Township plunging southwest. The southwest plunge continues uninterrupted into Ulysses Township, carrying the Catskill rocks so low that southwest of Pine Creek, Pocono and possibly younger rocks occur at the surface along the axis except in stream valleys. These post-Catskill rocks merge with the post-Catskill rocks of the Cowanesque and Pine Creek basins to form one broad belt. In central Summit Township the direction of axial plunge is reversed and a dome is developed in western Summit Township. Throughout Sylvania and Portage townships the axial plunge is southwest.

The Summit Township dome is quite definite, but it is not large, for within 2 miles along the axis strikes and dips indicate rapid plunge to northeast and southwest, while south flank dips of 4 to 5 degrees are observed a quarter mile south of the axis and on the north it is but 2 miles or less to the axis of the Cowanesque syncline. Wells favorably located structurally on this dome would start in the Pocono or higher; on Ayers Hill and Prooty branches of Sinnemahoning Creek wells would start not far below the Pocono.

Cross Fork anticline. There is some indication of folding in the vicinity of Cross Fork, northwestern Abbott Township. Evidence of reversal of dip was obtained only at Cross Fork Junction; at Hull Station, East Fork District, there is evidence of terracing. While our data are not sufficient to define this structure it seems probable that at this locality there is a minor fold of some prominence on the north limb of Marshlands anticline.

Marshlands anticline. This anticline extends from just east of the Potter County line to just west of Cameron County line in Elk County. The position of its axis is well marked in Potter County except northeast of Germania, where data are few and poor. Domes are present at Germania, near the west line of East Fork District, and northeast of Berge Run, Wharton Township.

The high of the Germania dome appears to extend from north of Cartee Camp to and possibly beyond Germania. Southwest plunge is definite but it is not clear where northeast plunge begins. That there is northeast closure is certain, however, as is attested by dying out of the anticline in western Tioga County. Chemung rocks are exposed in Germania, in the vicinity of which village a shallow gas field, now practically abandoned, was developed.

The high of East Fork-Wharton dome appears to be located near the boundary line of these townships. Northeast plunge of the axis is indicated by strikes and dips on Hammersly Fork and Dry Run, East Fork District and southwest plunge on Jordan Run, Wharton Township.

There is some evidence that a small dome exists in the extreme southwest corner of Wharton Township just northeast of Berge Run Station on the Buffalo & Susquehanna Railroad. It is suggested by a few data of good quality on the road between Berge Run and Wharton. On Elk Lick Run southeast of Wharton data show a definite southwest plunge, and in Cameron County south of Berge Run a southwest plunge is also indicated. The high of the Berge Run dome would therefore seem to extend from just northeast of Berge Run to about the head of Rattlesnake Run. Unfortunately no data are available in the axial area or on the immediate south flank.

Sinnemahoning Creek and its tributaries expose Chemung rocks in the vicinity of this structure.

Wellsboro anticline. This anticline crosses the southeast corner of Stewardson Township. Its length within the county is 8 miles. Where it enters from Tioga County the plunge of the axis is southwest. Data on Green Lick and Middle Branch of Young Womans Creek show a plunge to the northeast, indicating that a saddle is developed on this structure throughout most of its length in Potter County.

DEPTH TO THE ORISKANY SAND

The following well data are available to assist in estimating the depth that a well need be drilled in Potter County in order to reach the Oriskany sand.

Depth of Oriskany sand below Catskill red beds

Name of well	Location	Interval base of red beds to top of Oriskany
Matteson #1	Hebron Twp., Potter County	5,174**
F. Moe*	Allegany Twp., " "	5,316
Emporium Lumber Co., #1*	East Fork Dist. " "	5,689
Shoemacker	Lawrence Twp., Tioga "	5,502±
Wheeler, Ida	Delmar Twp., " "	5,629±
Weiboldt #1	Elk Twp., " "	5,709
Derrick City	Foster Twp., McKean "	4,268
Haywood Est.	Hamlin Twp., " "	4,919**
Kane Deep well	Highland Twp., Elk "	4,703**

*Allegheny Gas Co.; remainder after C. R. Fettke
**Oriskany sand absent

From these data we may expect that south and southeast of Hebron Field drilling distance below the red beds will increase; that west and northwest of Hebron Field the distance will decrease.

To aid in an estimate of the distance above the base of the Catskill a well starts at a given locality, the following few data are available:

Thickness of Catskill and Pocono formations

Locality	Thickness Catskill	Pocono
Northwest Potter County	370	400-
Keating Summit Keating Township, Potter County	250+	430
Cameron well and section Lumber Township, Cameron County	347	548
South Abbott Township, Potter County		650±
Western Tioga County	500±	
East Fork District, Potter County	590+	

From these data it would seem that the Catskill averages about 350 feet thick in the western part of Potter County and that the thickness increases to about 500 or 600 feet in the eastern part of the county. Unfortunately we do not have measurements of specific sections in the east part of the county and as the thickness of the Catskill is 1,016 feet at Hyner, Clinton Co., it is possible that its thickness in the southeast part of Potter County may exceed 600 feet.

DEVELOPMENT WORK IN THE ORISKANY SAND

Resume of developments to February 1, 1934

February 1, 1934, 26 wells had been drilled to the Oriskany sand in Potter County; of these, 17 were successful and 9 dry. Thirteen additional wells had been started; of these, 2 are definitely abandoned above the sand, 1 is temporarily abandoned, 8 are drilling or getting ready to drill and 2 are shut down.

All except two of the successful wells and two of the dry holes are on the Hebron anticline.

One of the two successful wells, not on Hebron anticline, the Moran (No. 16), is on the Smethport anticline in northeastern Oswayo Township near the New York State line. This well, completed in February 1932 had an initial output of 8 million cubic feet of gas at 1,950 pounds rock pressure and yielded much salt water with the gas. The Oriskany was found at 4,875 feet deep, -2,788 feet below sea level, and the well completed at 4,879 feet. The well has not been produced and no further effort has been made to develop a pool at this locality. Reconnaissance data are so few and poor in the vicinity of the well that the structural situation is not known to us. In near by New York State the axis of the Smethport anticline shows definite southwest plunge (Fig. 2). Near the well there is some slight indication of northeast plunge but northeast closure is by no means assured from our observations. The second well is the Emporium Lumber Co. (No. 14) on the Marshlands anticline in East Fork District. This well, 6,425 feet deep, found the Oriskany at 6,280 feet, 4,344 feet below sea level. The sand, 31 feet thick, gave an initial yield of 85,000 cubic feet a day. Rock pressure has not been determined but the well has been producing steadily against a line pressure of 800 pounds. A second well being drilled here had reached a depth of 5,960 feet February 1. These wells are located on a well-defined dome.

Both of the unsuccessful wells referred to above are on the Harrison anticline. They are the Moe (No. 24) and Franke (No. 27).

The Moe well, 5,440 feet deep, found the Oriskany at 5,316 feet, 2,911 feet below sea level. The sand was 10 feet thick but very fine and without gas or water. The well appears to be located within closure.

The Franke well, 5,881 feet deep, found the Oriskany hori-
n at 5,864 feet, 3,604 feet below sea level. It is reported that
distinct sand is present, the Oriskany at this locality consist-
g of cherty limestone that is incapable of serving as a gas reser-
ir. This well is on a well-defined dome that should offer ex-
llent opportunity for gas accumulation. Sand conditions apparently
e treacherous but the structure cannot be condemned by a single test.

Fourteen of the 15 successful wells on the Hebron anticline
e located within an area 2½ miles long and 1½ miles wide in east
ntral Hebron Township, called Hebron Field (Fig. 3). The other
ll, G. Estes (No. 26), is 5 miles northeast of this area. Whether
not the G. Estes represents a separate pool or a continuation of
e Hebron pool is not known.

The G. Estes well had an initial volume of 13 million cubic
et a day at 2,110 pounds rock pressure. The well is 5,199 feet
ep and found the Oriskany at 5,197 feet or 3,030 feet below sea
vel. The Gale well (No. 11), located 2,000 feet south of the G.
tes well, found the Oriskany at 3,521 feet below sea level. The
nd contained salt water. The Gale and Estes wells appear to be on
posite sides of a fault, probably the fault that is recognized
uth of the axis in Hebron Field.

The initial volume of the 14 successful wells in Hebron
eld ranges between a million and 33 million cubic feet a day, aver-
ges about 13 million and totals 183,850,000 cubic feet. Rock pres-
res range between 2,000 and 2,200 pounds per square inch.

Excluding one gas well, namely Champlin #2 (No. 21), eleva-
ions on the Oriskany range between 2,968 and 3,135 feet below sea
evel, showing a proven effective closure of 167 feet. As the A. J.
ite well (No. 28) got salt water at 3,203 feet below sea level it
s probable that the effective closure of the field will be about
0 feet.

The Champlin #2 well found gas in the Oriskany at 3,398 feet
elow sea level, more than 250 feet lower than probable effective
losure elsewhere in the field. As previously stated the south flank
f this fold is known to be faulted. It is probable that the Champ-
in well encountered closure on the downthrow side of the fault and
hat an independent pool may be developed in this structural position.
ault displacement as measured by the G. Estes (No. 26) and Gale (No.
1) wells is about 500 feet at that locality; as measured by the Champ-
in #2 and Wilsey (No. 29) wells it is about 275 feet. The Oriskany
and in the Champlin #2 is 123 feet higher than in the Gale well which
ot salt water.

Six dry holes have been drilled in the vicinity of Hebron
ield and 2 wells, the Champlin #1 (No. 8) and Gooch #1 (No. 30), were
bandoned above the sand. Of the dry holes, the Coyle (No. 15) is on
he south flank, and the A. J. White (No. 28) is on the north flank.

These wells found sand but are outside of effective closure. Four dry holes (Nos. 5, 19, 23, 33) are about 6 miles west of Hebron Field as it is now known. All these wells found the Oriskany sand to be absent or too thin and tight to serve as a reservoir. Champlin #1 was abandoned because of apparent excessive depth, Gooch #1 because of crooked hole.

It is apparent from the above that much development work remains to be done before the extent of Hebron Field is determined. Somewhere between the Carpenter #1 (No. 12) and the Matteson (No. 5) wells the Oriskany sand cuts out; on the east there remains to be proved how much of the interval between the Phelps (No.17) and the C Estes (No. 26) wells will be productive; south of the axis the significance of the Champlin #2 (No. 29) well has yet to be determined.

The Gas sand. The thickness of the Oriskany sand in the Emporium Lumber Co. well (No. 14), East Fork District, is 31 feet an in the Moe well (No. 24), Allegheny Township, 10 feet but no well ha definitely penetrated the Oriskany sand in Hebron Field. The Nugent well (No. 3) was completed 12 feet in the sand, at which depth it wa reported as drilling in shale, but there is no assurance that this represents total thickness.

Two specimens of Oriskany blown from Nugent #1 well when it was being drilled in were tested by C. R. Fettke for the Pennsylvani Geological Survey and showed 9.1 and 9.6 per cent porosity. In Tiog Field the porosity ranges from 4 to 12 and averages about 9 per cent

The gas is dry, sweet, and has a B.t.u. value of 1,020*. The sales price of gas at the well is said to be 10 to 12 cents a thousand cubic feet.

Pipe lines. When the field was discovered the only pipe li that had access to it was a small line of the Allegheny Gas Co. In 1932 the Empire Gas & Fuel Co. Ltd. built a small line into the fiel from New York State. In 1933 the Standard Oil Company of New Jersey built a 10-inch line to connect the field with their 20-inch line that runs from Tioga field, Tioga County, to Syracuse, New York and the United Natural Gas Co. built an 8-inch line to connect the field with their gathering system.

Cost of drilling. Wells equipped for production cost about $20,000 to complete. The contract price for drilling is $3.00 a foo Four to five hundred feet of 8¼-inch water string is set and 7-inch casing is cemented in the Onondaga lime.

Acreage. Practically all of the area shown on Fig. 3 is leased. The largest holders of acreage are — United Carbon, Lycomi Natural Gas, Allegheny Gas, Sylvania, Hunsinger, Cities Service, Penn United Gas, Sanderson et al., Hanley & Bird, and North Branch Develo ment.

The usual royalty is 1/8 or 1½ cents a thousand cubic feet of gas.

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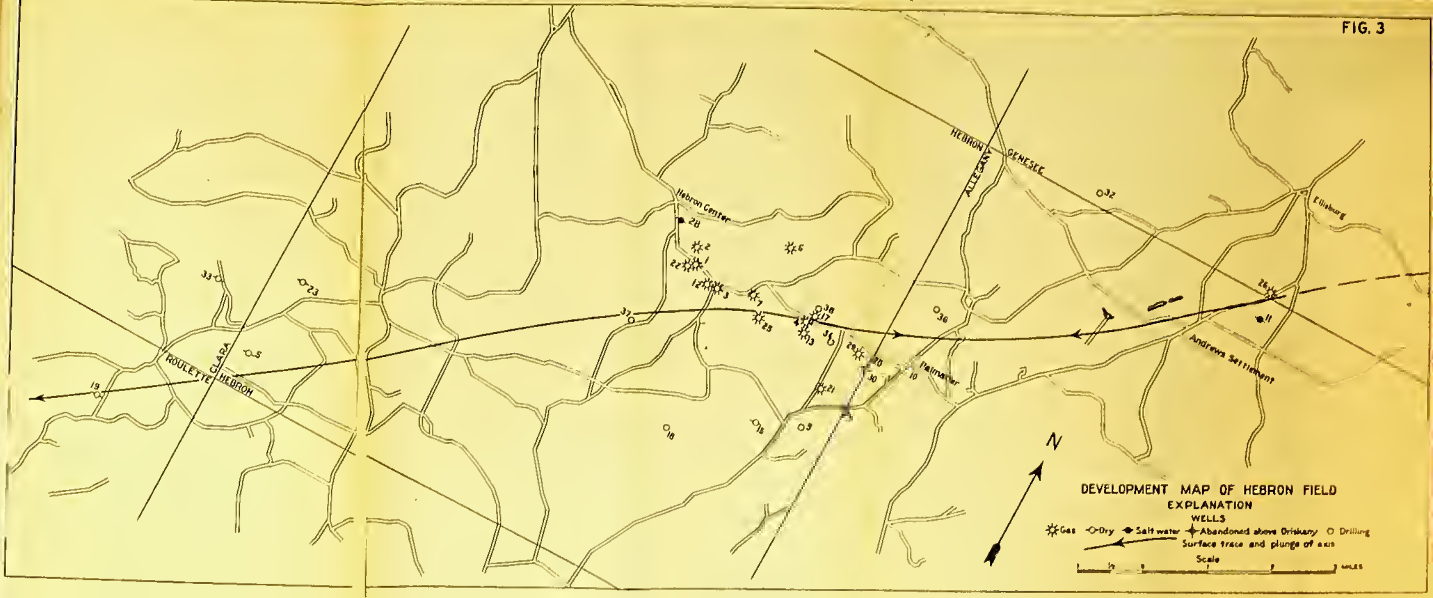
*Courtesy, Allegheny Gas Co.

FIG. 3



DEVELOPMENT MAP OF HEBRON FIELD

EXPLANATION

LIST OF WELLS

Map No.	Reported Owners	Name of well	Status		Results	Rock Pres. Initl.	Elev. ~~Depth~~	Total Depth	Tully Depth	S.L.	Onon. Depth S.L.	Orisk. Depth S.L.
1	Hungiville & Co.	Booth #1	Completed	11-11-31	8,250,000[1]	2135	1845	4924	3890- 4054	-2045	4893 -3048	4923 -3078
2	" "	" #2	"	9-17-32	7,750,000	2160	1973	5092	4485- 4541	-2512	5057 -3084	5088 -3115
3	Williamsport O.& G.	Nugent #1	"	6-24-32	16,500,000	2160	1869	4887	4250- 4300	-2381	4855 -2986	4876 -3007
4	Schrack et al	Tassell #1	"	7-14-32	18,000,000	2200	2034	5037	4398- 4460	-2364	5018 -2984	5031 -2997
5	Potter Dev. Co.	Matteson #1	Abd.	8-26-32	Dry no sd.[2]		2180	5550	4567- 4615	-2387	5147 -2967	5174 -2994
6	Rogers, G.H., et al	Clair, E.N. #1	Completed	10-21-32	3,600,000	2160	2154	5294	4690- 4732	-2536	5266 -3112	5289 -3135
7	Hungiville et al	Sturdevant #1	"	1-26-34	12,000,000		1940	4949	4325	-2385	4900 -2960	4934 -2994
8	Reed, J. B., et al	Champlin #1	Abd. 5005'	2-26-33	Abd.ab.Orisk.		2178	5005	4975	-2797?		
9	Updegraph	Coyle, E.A. #1	S.D. 4875'	1-26-34			2375					
10	Potter Dev. Co.	Cole, W.D. #1	" 3550'	11-24-33	Temp. abd.		2272					
11	Hammondsport O.& G.	Gale, W.L. #1	Abd.	10-31-32	Dry S.W.		2211	5744	4795- 4829	-4829	5695 -3484	5732 -3521
12	Potter Dev. Co.	Carpenter #1	Completed	11-20-32	7,250,000		1873	4872	4260- 4308	-2387	4850 -2977	4867 -2994
13	Wyoga Oil & Gas	Tassell #2	"	11-12-32	20,000,000[3]	2050	2211	5232	4622- 4660	-2411	5205 -2994	5229 -3018

14	East Penn Dev.Co.	Emp.Lumb.Co. #1	Completed	2-23-33	85,000[4]	>800	1936	6425	5523- 5588	-3589	6267 -4333	6280 -4344
15	Rogers, G. H.	Coyle, E.A. #1	Abandoned	7-6-33	Dry		2170	5888	5265	-3095	5858 -3688	5875 -3705
16	Cunningham, et al	Moran, J. #1	Completed	2-28-32	8,000,000[5] Plus S.W.	1950	2087	4879	4288- 4329	-2201	4852 -2765	4875 -2788
17	Sylvania Corp.	Phelps #1	"	3-30-33	12,000,000	2123	2160	5170	4551- 4604	-2391	5141 -2981	5163 -3003
18	Rodgers	Scutt #1	S.D. 4850'	1-26-34			2416					
19	Potter Dev. Co.	Allen, W.H. #1	Abd.	3-2-33	Dry no sd.		2217	5366	4707- 4752	-2490	5245 -3028	5271 -2984
20	Handley & Bird	Gooch, S. #2	Dr.4513'	2-9-34			2178					
21	Reed, J.B. et al	Champlin #2	Completed	1-26-34	1,000,000		2260	5659	5030	-2774	5621 -3361	5658 -3398
22	Potter Dev. Co.	Carpenter #2	"	7-27-33	14,000,000	2060	1834	4910½	4292	-2458	4876 -3042	4904 -3070
23	" " "	Sterns #1	Abandoned	6-1-33	Dry no sd.[6]		2026	5147	4537	-2511	5106 -3080	5140 -3114
24	P. P. & L.	Moe, F. #1	S.D. 5300'	9-14-33	Dry[7]		2405	5440	4665- 4715	-2260	5297 -2892	5316 -2911
25	Sylvania	Wilcox #1	Completed	8-17-33	14,500,000	2030	2140	5118	4512- 4564	-2372	5091 -2951	5113 -2973
26	Atwater et al	Estes, G. #1	"	9- 7-33	13,000,000	2110	2167	5199	4590- 4610	-2427	5170 -3007	5197 -3030
27	Bayliss et al	Franke, L. #1	"	9-28-33	Dry no sd.[8]		2260	5881	5192- 5242	-2932	5829 -3569	5864 -3604
28	[illegible] et al	White, A. L. #1	"	9-28-33	", S.W.[9]		1985	5195	4564	-2580	5163	5188

30	Handley & Bird	Gooch, S. #1	Abandoned 11-17-33	Abd.ab.sd.[11]		2205	4472			
31	East Penn Dev. Co.	Emp.Lumb.Co.#2	Dr. 6059' in sand 2- 9-34	[12]		1647		5316-5365 -3669	6038 -4391	6043 -4396
32	H.Baker & Britton et al	Russell,U.B.#1	S.D. 230' 2- 2-34			2343				
33	Potter Dev. Co.	Gray Chem.Co.	Completed 12-14-33	Dry no sd.		2176	5488	4799-4850 -2623	5380 -3204	5405 -3220
34	Sylvania	Higley, J.	" 1-26-34	16,000,000		2223	5289	4684 -2461	5271 -3048	5287 -3064
35	Penn United	Russell,U.B.1E	Dr. 5284' 2-9-34	[13]		2220		4692-4742 -2472	5268 -3048	5283 -3063
36	James Duff et al	Co. Comm.	" 4797' 2-9-34			2259		4753 -2494		
37	Potter Dev. Co.	Oswayo Chem.	Spud. 2-9-34							
38	United Prod.	Phelps, I.B.	R.U. 2-9-34							
39	P. P. & L.	Doty, Geo.	Cellar 2-9-34	[14]						

These well data are published by courtesy of operators. Acknowledgement is especially due to The Allegheny Gas Co.

[1] Discovery well.

[2] St. 56' below base Dok. Shot 5160-90, 200 quarts.

[3] Blew out.

[4] 75,000 feet in Oriskany. Plugged back. Shot 6279-94, 100 quarts. 31 feet Oriskany sand.

[5] Eight million cubic feet of gas with much salt water.

[6] Four feet of hard sand.

[7] Ten feet tight sand, 5316 to 5326 feet.

[8] No sand, only cherty lime.

[9] Four thousand feet salt water.

[10] One hundred and forty-five thousand cubic feet at 1195-1200. Reported up to 60 million in Oriskany.

[11] Abandoned above sand caving hole.

[12] Gas. Well drilling in Oriskany 2-9-34.

[13] Two hundred and fifty thousand cubic feet at top sand. Drilling in sand 2-9-34.

[14] Hector Township. Sabinsville anticline.